Radiation Exposure in Growing Rod Surgery for Early Onset Scoliosis

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5th INTERNATIONAL CONGRESS ON EARLY ONSET SCOLIOSIS
Copenhagen, Denmark – November 18-19, 2011

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DISCLOSURES

Author	Disclosure
Michael W. Hennessy, MD	None
Jeff B. Pawelek, BS	None
Behrooz A. Akbarnia, MD	DePuy Spine (a,b); Ellipse (a,b,c); K2M (a,b); K Spine (b,c); Nuvasive (a,b,c); Nocimed (c)
Gregory M. Mundis, Jr., MD	Nuvasive (a,b,d); K2M (a,b); DePuy Spine (a,e)

a. Grants/Research Support
b. Consultant
c. Stock/Shareholder
d. Speakers' Bureau
e. Other Financial Support

INTRODUCTION

– Potential health hazards due to ionizing radiation are well-known

– ACUTE RADIATION EXPOSURE:

- Erythema / dermatitis
- Whole body exposure causes nausea, vomiting, diarrhea, weakness, possibly even death

– CHRONIC RADIATION EXPOSURE:

- Bone marrow suppression
- Potential genetic defects leading to congenital defects in offspring
- Multiple neoplasms have been linked to IR exposure:
  - Leukemia
  - Skin
  - Thyroid
  - Breast
  - Bladder
  - Colon
  - Liver
  - Lung
  - Esophagus
  - Ovarian
  - Multiple Myeloma
  - Gastric

INTRODUCTION

Degree of radiation exposure depends on several factors:

- Amount of radiation
- Duration of exposure
- Distance from source
- Type of shielding

Treatment of early onset scoliosis (EOS) with growing rod surgery (GR) requires multiple radiographic studies during course of treatment.

No study to our knowledge has looked at the radiation exposure in GR for treatment of EOS.

The purpose of this *pilot* study was to quantify radiation exposure in EOS.

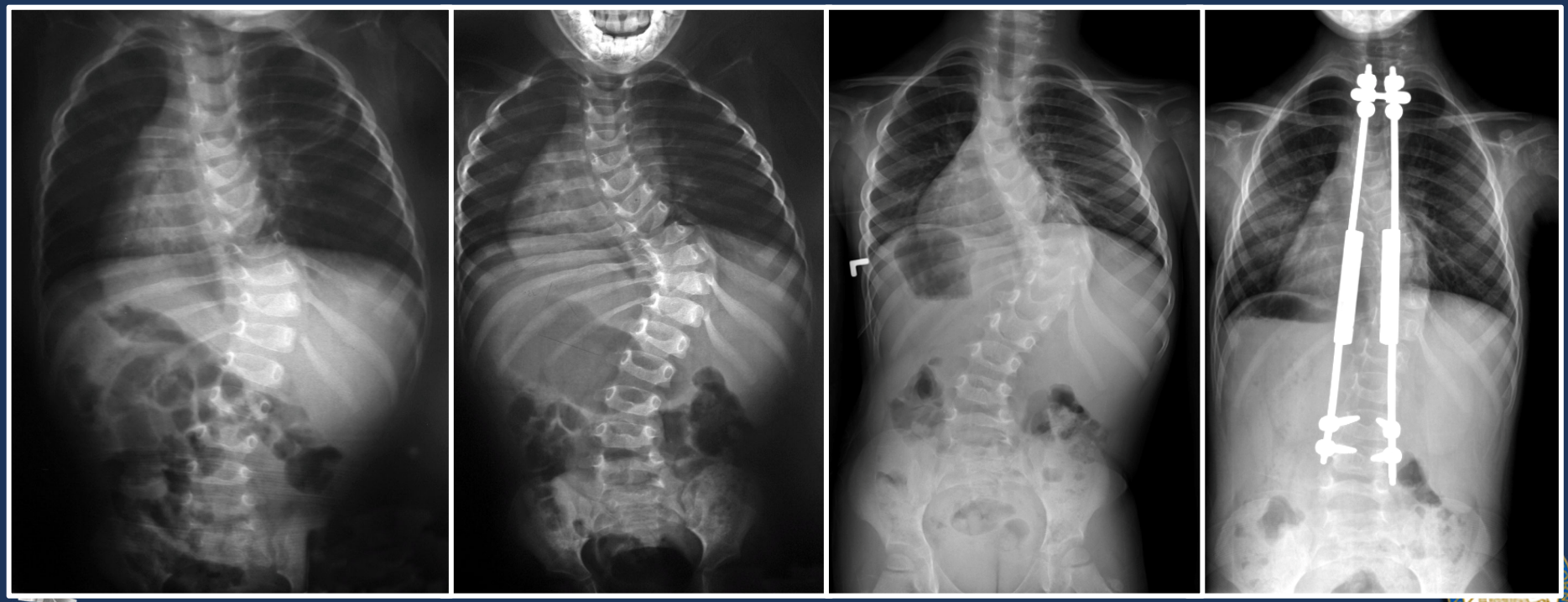
METHODS

- IRB approved, single-center retrospective review

- Inclusion criteria:
  - Idiopathic and syndromic scoliosis
  - Diagnosed under age 11 years old
  - Growing rod surgery only
  - One year follow up
- Reviewed records between 1997 and 2010
- 10 patients met inclusion criteria
  - Two patients were excluded; one due to lack of complete surgical and radiographic history, one due to less than 1 year follow up

METHODS

- All spine-related radiographic studies using ionizing radiation (IR) were recorded for each patient
- Estimated IR was measured in millisieverts (mSv)



METHODS

- IR calculated based on historical controls
  - Estimated radiation from each radiologic study:

Full Spine	Chest	CT Spine Cervical/Thoracic/Lumbar	CT Chest
1.5 mSv	0.1 mSv	2 / 2 / 2 mSv	2 mSv

- Estimated annual Background Radiation (BR) exposure:
  - 2.4 mSv per year
  - Highest average reported in USA

RESULTS

- Mean age at time of first spine x-ray = 4.3 years
  - Range: birth to 9.7 years
- Mean follow-up from initial assessment = 4.8 years
  - Range: 1.2 to 14.8 years
- Mean number of spinal distractions = 2.9 distractions
  - Range: 0 to 10 distractions
- Total of 45 (1-12) spine-related procedures for all 10 patients
- 4 of 10 patients underwent "final" spinal fusion

RESULTS

Summary of IR Data:

Patient	Diagnosis	Length of Spine Care (years)	Total Spine-related IR Exposure (mSv)	Average IR per Spine Surgery (mSv)	Total Estimated Background Radiation (mSv)	Final Fusion?
1	IIS	14.8	138.1	11.5	35.4	Y
2	CON	7.9	56.9	28.5	18.9	Y
3	CON	6	81.2	20.3	14.3	N
4	IIS	4.8	37.2	3.4	11.6	N
5	JIS	4.7	27	13.5	11.2	N
6	JIS	2.3	37.6	9.4	5.4	Y
7	JIS	2.3	29.6	29.6	5.5	N
8	IIS	2.2	52.1	10.4	5.2	N
9	CON	2.1	14.9	14.9	5.1	Y
10	IIS	1.2	24.2	8.1	2.9	N

RESULTS

Summary of IR Data:

- Total estimated IR for all 4 patients = 504.0 mSv
- Average IR per spine procedure: 14.8 mSV
  - 6.4 times annual background radiation
- Average IR per year of spine treatment: 12.4 mSv
  - 5.2 times annual background radiation

DISCUSSION

- Our small series of 10 patients received at least 5 times the average annual background radiation dose for each year of spine treatment

- 2 of 10 patients were older than the typical growing rod patient at time of initial surgery

LIMITATIONS

- IR exposure was grossly underestimated:
  - Historical controls based on "average" sized adult
  - No record of number of actual x-rays taken for each study (repeated x-rays due to over/underexposure)
  - Patients had other IR-emitting imaging studies unrelated to their spinal deformity

DISCUSSION

- A prospective study would be able to:
  - Obtain actual IR dose for each medical image taken
  - Account for number of attempts to obtain satisfactory radiograph including spine and non-spine imaging
  - Ultimately determine if IR exposure for growing rod patients can be decreased by augmenting imaging regimen

DISCUSSION

- Recent FDA investigations have raised awareness of CT scanner radiation exposure and have encouraged the usage of low-dose CTs
- New orthopedic imaging technology decreases the amount of radiation per exam (e.g. EOS)

THANKS